

APPELLANTS' BRIEF AND APPENDIX

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:)	
Randal Howard Kerstetter III, et al.)	Confirmation No.: 7153
For: COMPOSITE HAVING RUBBER)	Docket No.: DN2002101
COMPOUND WITH HYDROTALCITE)	Art Unit: 1772
Serial No.: 10/624,742)	Examiner: Michael C. Miggins
Filed: July 21, 2003)	

**BEFORE THE BOARD OF
PATENT APPEALS AND
INTERFERENCES**

Board of Patent Appeals and Interferences
United States Patent and Trademark Office
P. O. Box 1450
Alexandria, Virginia 22313-1450

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AUG 30 2006

TC 1700

APPELLANTS' BRIEF

Dear Sir:

Appellants, by virtue of his Notice of Appeal filed June 26, 2006, hereby file their Brief in response to the Final Rejection of all pending claims in the above-identified application. Please charge my Deposit Account No. 07-1725 in the amount of Five Hundred and 00/100 Dollars (\$500.00) to cover the fee for filing this Brief in support of this Appeal. Any deficiency or overpayment should be charged to this Deposit Account.

Real Party in Interest

By virtue of an Assignment dated July 18, 2003, by the named inventors, the real party in interest is The Goodyear Tire & Rubber Company. The July 18, 2003, Assignment has not been recorded in the U.S. Patent and Trademark Office.

Related Appeals and Interferences

Appellants are not aware of any appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending Appeal.

Status Of The Claims

Claims 1 through 20 stand rejected and are subject to this Appeal. A copy of claims 1

through 20 appear in the Claims Appendix of this Brief.

Status Of Amendments

No amendment after Final Rejection under 37 C.F.R. Section 1.116 was filed.

Summary Of The Claimed Subject Matter

Independent claim 1 is directed to a composite material comprising textile fibers having distributed over surface portions thereof an RFL adhesive, and a vulcanizable rubber composition comprising 50 to 100 parts by weight of polychloroprene rubber, zero to 50 parts by weight of at least one additional rubber, and from about 0.1 to about 40 parts by weight of a hydrotalcite (page 2, lines 11 through 15).

Independent claim 11 is directed to a method of adhering textile fibers to a vulcanizable rubber composition in a composite material, comprising obtaining textile fibers having distributed over surface portions thereof an RFL adhesive, and contacting the textile fibers with a vulcanizable rubber composition comprising 50 to 100 parts by weight of polychloroprene rubber, zero to 50 parts by weight of at least one additional rubber, and from about 0.1 to about 40 parts by weight of a hydrotalcite (page 2, lines 16 through 21).

Grounds of Rejection to be Reviewed on Appeal

The first issue and only before the Board of Patent Appeals and Interferences is whether Claims 1 through 20 are properly rejected under 35 U.S.C. Section 103(a) as being unpatentable over Igarashi, U.S. Patent No. 5,348,779, in view of Li, U.S. Patent No. 6,046,262, and Biggs, U.S. Patent No. 4,436,774.

ARGUMENT

Claims 1 through 3 and 5 through 20 Rejected Under 35 U.S.C. Section 103(a)

Claims 1 through 20 are rejected under 35 U.S.C. Section 103(a) as being unpatentable over Igarashi in view of Li and Biggs. Appellants urge that no motivation exists to combine the teachings of Igarashi, Li and Biggs to arrive at the present claims, and

therefore no *prima facie* obviousness has been established. Appellants argue in the alternative that even if *prima facie* obviousness exists, the present specification includes a showing of unexpected results sufficient to overcome *prima facie* obviousness.

To establish a *prima facie* case of obviousness, the PTO must satisfy three requirements. First, the prior art relied upon, coupled with the knowledge generally available in the art at the time of the invention, must contain some suggestion or incentive that would have motivated the skilled artisan to modify a reference or to combine references. *See Karsten Mfg. Corp. v. Cleveland Gulf Co.*, 242 F.3d 1376, 1385, 58 U.S.P.Q.2d 1286, 1293 (Fed. Cir. 2001) ("In holding an invention obvious in view of a combination of references, there must be some suggestion, motivation, or teaching in the prior art that would have led a person of ordinary skill in the art to select the references and combine them in the way that would produce the claimed invention."); *C.R. Bard, Inc. v. M3 Sys., Inc.*, 157 F.3d 1340, 1352, 48 U.S.P.Q.2d 1225, 1232 (Fed. Cir. 1998) (a showing of a suggestion, teaching, or motivation to combine the prior art references is an "essential evidentiary component of an obviousness holding"). *Northern Telecom v. Datapoint Corp.*, 908 F.2d 931, 934, 15 U.S.P.Q.2d 1321, 1323 (Fed. Cir. 1990). (It is insufficient that the prior art disclosed the components of the patented device, either separately or used in other combinations; there must be some teaching, suggestion, or incentive to make the combination made by the inventor."); *Abbott Laboratories v. Syntron Bioresearch, Inc.*, 334 F.3d 1343, 67 U.S.P.Q.2d 1337 (Fed. Cir.), *reh'g denied*, 2003 U.S. App. LEXIS 17605 (2003). ("Knowledge in the prior art of every element of a patent claim, however, is not of itself sufficient to render claim obvious. The issue is whether substantial evidence supports the judgment (under the clear and convincing evidence standard) that a person having ordinary skill in the art would not have been motivated to replace the [prior art process] with [the process of the invention].") Motivation to modify a reference may be lacking where the prior art teaches away from such

a modification. *In re Gurley*, 27 F.3d 551, 31 U.S.P.Q.2d 1130 (Fed. Cir. 1994) ("A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant. The degree of teaching away will of course depend on the particular facts; in general, a reference will teach away if it suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the applicant.") If a proposal for modifying the prior art in an effort to attain the claim invention causes the art to become inoperable or destroys its intended function, then the requisite motivation to make the modification would not have existed. *See In re Fritch*, 972 F.2d at 1260, 1265 n.12, 23 U.S.P.Q. 2d 1780, 1783 n.12 ("A proposed modification [is] inappropriate for an obviousness inquiry when the modification render[s] the prior art reference inoperable for its intended purpose."); *In re Ratti*, 270 F.2d 810, 813, 123 U.S.P.Q. 349, 352 (C.C.P.A. 1959) (holding the suggested combination of references improper under §103 because it "would require a substantial reconstruction and redesign of the elements shown in [a prior art reference] as well as a change in the basic principles under which [that reference's] construction was designed to operate").

Second, the proposed modification of the prior art must have had a reasonable expectation of success, determined from the vantage point of the skilled artisan at the time the invention was made. In other words, a hindsight analysis is not allowed. *See Amgen, Inc. v. Chugai Pharm. Co.*, 927 F.2d 1200, 1209, 18 U.S.P.Q.2d 1016, 1023 (Fed. Cir. 1991) (While the idea of using a monkey gene to probe for a homologous human gene may have been "obvious to try," many pitfalls existed that would have eliminated a reasonable expectation of successfully obtaining the EPO gene. "Hindsight is not a justifiable basis on which to find that ultimate achievement of a long sought and difficult scientific goal was obvious."); *In re Erlich*, 3 U.S.P.Q.2d 1011, 1016 (Bd. Pat. App. & Int. 1986) ("at the time the invention was

made, one of ordinary skill in the art would have been motivated to produce monoclonal antibodies specific for human fibroblast interferon using the method of [the prior art] with a reasonable expectation of success.").

Lastly, the prior art reference or combination of references must teach or suggest all the limitations of the claims. *See In re Wilson*, 424 F.2d 1382, 1385, 165 U.S.P.Q. 494, 496 (C.C.P.A. 1970) ("All words in a claim must be considered in judging the patentability of that claim against the prior art.").

A *prima facie* case of obviousness may be refuted by a showing of unexpectedly superior results. *In re Soni*, 54 F.3d 746, 34 U.S.P.Q. 2d 1684 (Fed. Cir. 1995).

Appellants urge that no motivation exists to combine the teachings of Iragashi, Li and Biggs to arrive at the present claims.

Iragashi teaches a hose and hose nipple combination wherein a sealing layer of chlorinated elastomer is used to bond the hose 14 and nipple 12 (Column 9, Lines 7 through 22). In one embodiment, sealing layer 16 overlays nipple 12 (Fig. 5), and in another embodiment sealing layer 20 overlays resin layer 2 (Fig. 6). The sealing layer may comprise chlorosulphonated polyethylene or chlorinated polyethylene rubbers (Column 9, Lines 48 through 53) and hydrotalcite (Column 9, Lines 23 through 47). Nowhere does Iragashi teach that the sealing layer may comprise polychloroprene; the only mention of polychloroprene in Iragashi is directed to its use in the cover layer of a prior art hose (Column 1, Lines 31 through 33). By contrast, Iragashi teaches a sealing layer 16 or 20 that may comprise chlorosulphonated polyethylene rubber or chlorinated polyethylene rubber (Column 9, Lines 48 through 53) and hydrotalcite (Column 9, Lines 27 through 30). The sealing layer 16 is provided on the outer surface of nipple 12 to adhere nipple 12 to layer 2 of hose 14 (Figure 5); alternatively sealing layer 20 is provided on the inner surface of hose 18 to adhere the nipple (Figure 6). It would be clear to one skilled in the art from the teaching of Iragashi that such a sealing layer composition is useful for adhering a hose to an ostensibly metal hose

nipple. One skilled in the art would not understand that such a composition may be as a rubber composition to adhere to textile fiber as in the present claims, nor would one skilled in the art understand that polychloroprene could be substituted for the chlorosulphonated polyethylene rubber or chlorinated polyethylene rubber.

Nowhere does Iragashi teach nor make obvious a composite material as recited in claim 1. Iragashi does not teach nor make obvious a vulcanizable rubber composition comprising polychloroprene and hydrotalcite at all; Iragashi teaches only the use of chlorosulphonated polyethylene or chlorinated polyethylene rubbers with hydrotalcite as a nipple adhesive for a hose. Moreover, Iragashi does not teach nor make obvious a composite material comprising textile fibers having distributed over surface portions thereof an RFL adhesive and a vulcanizable rubber composition, wherein the vulcanizable rubber composition comprises 50 to 100 parts by weight of polychloroprene rubber, 0 to 50 parts by weight of at least one additional rubber, and from about 0.1 to 40 parts by weight of a hydrotalcite.

Nowhere does the cited art teach the use of hydrotalcite with polychloroprene. The Examiner equates the teaching of Iragashi regarding the use of polychloroprene (i.e., chloroprene rubber) at column 1, lines 31 through 33 with the use of chlorosulphonated polyethylene or chlorinated polyethylene (Office Action mailed 2/22/2006, paragraph 4); Appellants urge that Iragashi teaches only that polychloroprene may be used in hose covers, but teaches nothing about the use of hydrotalcite with polychloroprene. Indeed, at column 9, lines 23 through 30, Iragashi teaches that hydrotalcite may be used as an acid receptor with a "chlorinated elastomer", and then defines "chlorinated elastomer" at column 9, lines 48 through 50: "The chlorinated elastomer in which the acid receptor is dispersed is an elastomer chlorinated as a result of reaction of an elastomer with chlorine. The chlorinated elastomers may be chlorosulphonated polyethylene rubber or chlorinated polyethylene rubber."

Appellants urge first that polychloroprene is not "an elastomer chlorinated as a result of reaction of an elastomer with chlorine." Instead, polychloroprene is an elastomer resulting from the polymerization of a chlorine-substituted monomer, as evidenced by the excerpt from The Vanderbilt Rubber Handbook, 13 Ed., enclosed as Attachment A. As noted in Attachment A, polychloroprene (i.e., neoprene) is an elastomer resulting from the polymerization of chloroprene, and is not the result of a reaction of an elastomer with chlorine. Appellants urge that Iragashi does not therefore teach the use of polychloroprene with hydrotalcite, and in fact teaches only the use with "elastomer[s] chlorinated as a result of reaction of an elastomer with chlorine," which clearly excludes polychloroprene based on the teaching of Attachment A. As none of the cited art teaches or suggests the use of hydrotalcite with polychloroprene, no *prima facie* obviousness is established.

Moreover, Appellants note that the Examiner is in error regarding the assertion that polychloroprene is equivalent to chlorosulphonated polyethylene or chlorinated polyethylene. The Examiner states that "chlorinated polyethylene is a genus which contains polychloroprene since both are chlorinated ethylenes ." (Office Action mailed 2/22/2006, paragraph 4) With reference again to Attachment A, it is clear that the Examiner is in error; polychloroprene is not a chlorinated ethylene but rather a polymer of 2-chloro-1,3 butadiene, i.e., a polymer of chlorine-substituted butadiene, and is therefore not of the genus of chlorinated polyethylene. As none of the cited art teaches or suggests the use of hydrotalcite with polychloroprene, no *prima facie* obviousness is established.

Further, the Examiner suggests that "chlorosulphonated polyethylene or chlorinated polyethylene rubber . . . are structurally similar to polychloroprene." (Office Action mailed 2/22/2006, paragraph 4) The Examiner has provided no further evidence to support this assertion; nowhere does the cited art teach anything about the equivalence of polychloroprene and chlorosulphonated polyethylene or chlorinated polyethylene. Nor has the Examiner

complied with a request by Appellants to provide an affidavit under 37 CFR 1.104(d)(2) to attest to the equivalence of polychloroprene and chlorosulphonated polyethylene or chlorinated polyethylene rubber. Short of this, the assertion is unsubstantiated, no cited art teaches the use of polychloroprene and hydrotalcite, and no *prima facie* obviousness is established.

Li is cited by the Examiner as teaching the use of RFL with fiber reinforcement. Appellants urge that such a combination does not arrive at the present claims. Again, Iragashi simply does not teach a polychloroprene and hydrotalcite rubber composition at all, let alone in a composite with a fiber reinforcement treated with an RFL adhesive. Nor does Li teach nor make obvious a composite material as in the present claims; nowhere does Li suggest that an RFL treated fiber may be used in a composite material with a rubber composition comprising polychloroprene and hydrotalcite. At best, Li teaches that an RFL treated fiber may be used with natural rubber, polyurethane rubber, styrene-butadiene rubber, acrylonitrile-butadiene rubber, butyl rubbers, fluorinated rubbers, and EPDM (Column 3, Lines 5 through 10). Appellants urge that one skilled in the art would not be motivated to substitute the RFL treated fibers of Li for the fiber layer 6 of Iragashi, and even if Iragashi and Li were combined one would not arrive at the present claims; there is simply no teaching in either Iragashi or Li alone or in combination directed to a rubber composition comprising polychloroprene and hydrotalcite.

Further, the Examiner maintains that, regarding the teaching of Li about the adhesion of RFL treated fibers to fluorinated rubbers, "if the RFL treated fiber can be bounded (sic) to fluorinated rubbers, they certainly can be bonded to chlorinated rubbers for the purpose of providing improved adhesion between the fiber layer and the rubber layer since both rubbers are halogenated." (Office Action mailed 2/22/2006, paragraph 4) Appellants note that the Examiner is apparently relying on personal opinion to support the assertion that the adhesion

of RFL treated fibers to fluorinated rubbers is equivalent to the adhesion of RFL treated fibers to chlorinated rubbers "since they are both halogenated." The Examiner has provided no evidence to support this assertion; nowhere does the cited art teach anything about the equivalence of the adhesion of RFL treated fibers to fluorinated rubbers and the adhesion of RFL treated fibers to chlorinated rubbers. Nor has the Examiner complied with a request by Appellants to provide an affidavit under 37 CFR 1.104(d)(2) to attest to the equivalence of the adhesion of RFL treated fibers to fluorinated rubbers and the adhesion of RFL treated fibers to chlorinated rubbers "since they are both halogenated." While the Examiner asserts in the Advisory Action mailed 5/31/2006 that no opinion is being expressed, Appellants urge that the Examiner still has not provided evidence to support the assertion that simply because both rubbers are halogenated (albeit with different halogens) the rubbers are equivalent. Short of this, the assertion is unsubstantiated, no cited art teaches the use of RFL treated fiber with a polychloroprene and hydrotalcite, and no *prima facie* obviousness is established.

Biggs is cited only for its teaching with regard to a combination of polychloroprene with a second rubber, and does not impact the question of motivation to combine Iragashi and Li.

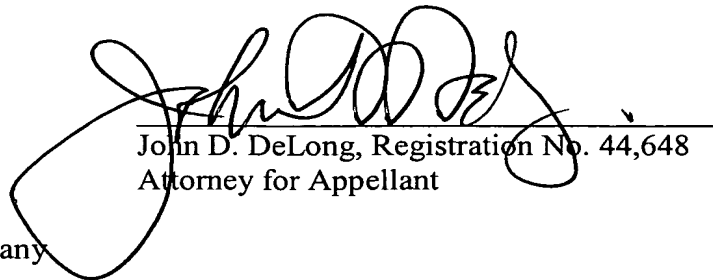
Appellants urge that since no motivation exists to combine Iragashi, Li and Biggs and even if combined, such a combination would not arrive at the present claims, *prima facie* obviousness has not been established.

Appellants further urge that even if *prima facie* obviousness exists, the present specification includes evidence of unexpected results sufficient to overcome *prima facie* obviousness. Iragashi teaches that the acid receptive agents used therein may equally be selected from MgO and hydrotalcite, among others, and that MgO is preferably used (Column 9, Lines 27 through 30). However, as noted in the present disclosure at Page 2, Lines 4 through 8, while MgO is often used as an acid acceptor (i.e., acid receptive agent) in

polychloroprene compounds, its use generally compromises adhesion in polychloroprene composites. Thus, while Iragashi teaches the preferential use of MgO, the present specification teaches that its use is undesirable. Moreover, in the Examples of the present specification it is clearly demonstrated that polychloroprene composites made using hydrotalcite in place of MgO show unexpectedly and surprisingly higher adhesion between the polychloroprene composition and the fiber reinforcement of the composite. As seen in Tables 3 and 4, Sample 9 made with hydrotalcite showed a substantial increase in adhesion of the polychloroprene compound to nylon fabric as compared to Sample 7 made with MgO; the increase in adhesion for Sample 9 vs. Sample 7 was 248 vs. 155 N/25 mm, for a increase of 60 percent. This increase in adhesion for the polychloroprene composite using hydrotalcite instead of MgO is clearly unexpected and surprising in view of the closest prior art, Igarashi, wherein it is taught that MgO is preferred over hydrotalcite. Appellants urge that this showing of unexpected results is sufficient to overcome *prima facie* obviousness of the claims.

Based upon the foregoing, Appellants respectfully request reconsideration of the pending claims and earnestly solicits a reversal of the Examiner's Final Rejection.

Respectfully submitted,



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CLAIMS APPENDIX

WHAT IS CLAIMED IS:

1. A composite material comprising textile fibers having distributed over surface portions thereof an RFL adhesive; and a vulcanizable rubber composition comprising:
 - 5 (A) 50 to 100 parts by weight of polychloroprene rubber;
 - (B) zero to 50 parts by weight of at least one additional rubber; and
 - (C) from about 0.1 to about 40 parts by weight of a hydrotalcite.
2. The composite material of claim 1, wherein said at least one additional rubber is selected from the group consisting of poly-epichlorohydrin, polyisobutylene,
10 halogenated-polyisobutylene, natural rubber, polyisoprene, polybutadiene, styrene-butadiene rubber, ethylene propylene diene terpolymer (EPDM), and mixtures thereof.
3. The composite material of claim 1, wherein said at least one hydrotalcite comprises a compound of formula I
$$\text{Mg}_{(1-x)}\text{Al}_x(\text{OH})_2(\text{CO}_3)_{x/2} \bullet n \text{H}_2\text{O}; \quad 0.25 < x < 0.33. \quad (\text{I})$$
- 15 4. The composite material of claim 1, wherein said textile fiber are selected from the group consisting of woven fabrics, knitted fabric, or spun bonded fabric, and fiber cord.
5. The composite material of claim 1, wherein said textile fibers comprises a material selected from the group consisting of rayon, nylon, polyester, aramid, cotton,
20 and combinations thereof.
6. The composite material of claim 1, wherein textile fibers comprises nylon.
7. The air sleeve of claim 1, further comprising at least one second acid acceptor selected from the group consisting of magnesium oxide, calcium oxide, calcium
25 hydroxide, and lead oxide.

8. The air sleeve of claim 1, wherein said hydrotalcite is present in an amount ranging from about 0.5 to about 20 parts by weight.

9. The air sleeve of claim 1, wherein said hydrotalcite is present in an amount ranging from about 1 to about 10 parts by weight.

5 10. The composite material of claim 1 wherein said composite material is a component of an air sleeve, automotive belt, tire, conveyor belt, automotive hose, fuel transport hose, or automotive track

11. A method of adhering textile fibers to a vulcanizable rubber composition in a composite material, comprising

10 (A) obtaining textile fibers having distributed over surface portions thereof an RFL adhesive; and

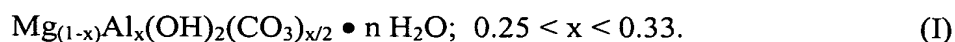
(B) contacting said textile fibers with a vulcanizable rubber composition comprising:

- 15 (1) 50 to 100 parts by weight of polychloroprene rubber;
- (2) zero to 50 parts by weight of at least one additional rubber; and
- (3) from about 0.1 to about 40 parts by weight of a hydrotalcite.

12. The method of claim 11, wherein said at least one additional rubber is selected from the group consisting of poly-epichlorohydrin, polyisobutylene, halogenated-polyisobutylene, natural rubber, polyisoprene, polybutadiene, styrene-butadiene rubber, ethylene propylene diene terpolymer (EPDM), and mixtures thereof.

20

13. The method of claim 11, wherein said at least one hydrotalcite comprises a compound of formula I



14. The method of claim 11, wherein said textile fiber are selected from the group consisting of woven fabrics, knitted fabric, or spun bonded fabric, and fiber cord.

25

15. The method of claim 11, wherein said textile fibers comprises a material selected from the group consisting of rayon, nylon, polyester, aramid, cotton, and combinations thereof.

16. The method of claim 11, wherein textile fibers comprises nylon.

5 17. The method of claim 11, wherein said vulcanizable rubber composition further comprises at least one second acid acceptor selected from the group consisting of magnesium oxide, calcium oxide, calcium hydroxide, and lead oxide.

18. The method of claim 11, wherein said hydrotalcite is present in an amount ranging from about 0.5 to about 20 parts by weight.

10 19. The method of claim 11, wherein said hydrotalcite is present in an amount ranging from about 1 to about 10 parts by weight.

20. The method of claim 11, wherein said composite material is a component of an air sleeve, automotive belt, tire, conveyor belt, automotive hose, fuel transport hose, or automotive track.

EVIDENCE APPENDIX

ATTACHMENT A

THE VANDERBILT RUBBER HANDBOOK



Thirteenth Edition

Edited by Robert F. Ohm

Published by



R. T. Vanderbilt Company, Inc.
INDUSTRIAL MINERALS AND CHEMICALS

30 Winfield Street, P.O. Box 5150, Norwalk, CT 06856 (203) 853-1400

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Price \$100.00

THE NEOPRENES

by Robert P. Kane

E. I. DuPont de Nemours & Co., Inc.
Wilmington, Delaware 19898

Neoprene is the generic name for polymers of chloroprene (2-chloro-1,3-butadiene) introduced commercially in 1931 by Du Pont. Neoprene currently is being manufactured in the United States by Du Pont (at Louisville, KY; and La Place, Louisiana) and by Mobay Synthetic (at Houston, Texas). Du Pont presently offers 24 types of solid neoprene and 9 types of neoprene latex.

Neoprene is also manufactured by Du Pont in the United Kingdom and in Japan by Showa Denko Du Pont, via a joint venture. These plants offer products similar to those manufactured in the United States, plus some additional unique types not available elsewhere.

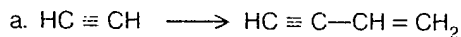
Other overseas producers of conventional polychloroprenes are Bayer in Germany, Distugil in France, and Denka and Toyo Soda in Japan. Manufacturing facilities are also located in the U.S.S.R and Peoples Republic of China.

Manufacture

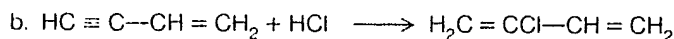
Chloroprene, 2-Chloro-1,3-butadiene, the monomer from which all neoprenes are made, is produced by two major processes, one using acetylene, and the other using butadiene. Today, most chloroprene is produced from butadiene.

1. Acetylene Process

CuCl

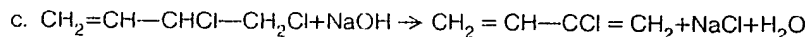
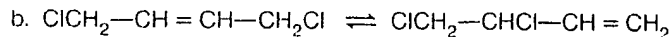
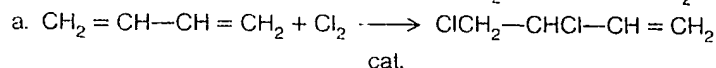


CuCl



2. Butadiene Process

$\text{ClCH}_2-\text{CH}=\text{CH}-\text{CH}_2\text{Cl}$



Chloroprene the system is all time and temperature resulting polymerization of the emulsions of chloroprene pH levels to specifications. The molecular structure of 2-butenylene is molecular structure of the following sun neoprene polymer

Type of Addition

Trans 1,4

Cis 1,4

1,2

3,4

The 1,2 addition of chlorine available principal site of v largely dependent on increasing amount

Chloroprene is emulsified in water, catalysts and modifiers are added and the system is allowed to polymerize under carefully controlled conditions of time and temperature. The reaction is terminated by short-stops and the resulting polymer is chemically stabilized. Dry polymer results from coagulation of the emulsion followed by drying. Latices, which are colloidal suspensions of chloroprene polymers, are finished and stabilized by adjustment of pH levels to specified values, usually 11 or higher.

The molecular structures of neoprene polymers are primarily of trans-chloro-2-butenylene units, but three other configurations occur. The different molecular structures and configurations of the monomer units are shown in the following summary with the approximate proportions occurring in a typical neoprene polymer.

Type of Addition	Configuration	Approximate Percent
<i>Trans 1,4</i>	$ \begin{array}{c} \text{H}_2 \quad \text{H} \\ \quad \\ -\text{C} = \text{C}- \\ \quad \\ \text{Cl} \quad \text{H}_2 \end{array} $	88-92%
<i>Cis 1,4</i>	$ \begin{array}{c} \text{H}_2 \quad \text{H}_2 \\ \quad \\ -\text{C} = \text{C}- \\ \quad \\ \text{Cl} \quad \text{H} \end{array} $	7-12%
<i>1,2</i>	$ \begin{array}{c} \text{H}_2 \quad \text{Cl} \\ \quad \\ -\text{C} - \text{C}- \\ \\ \text{CH} \\ \\ \text{CH}_2 \end{array} $	1.5%
<i>3,4</i>	$ \begin{array}{c} \text{H}_2 \quad \text{H} \\ \quad \\ -\text{C} - \text{C}- \\ \\ \text{C}-\text{Cl} \\ \\ \text{CH}_2 \end{array} $	1.0%

The 1,2 addition of 2-chloro-1,3-butadiene results in polymer having some chlorine available in allylic form. This is a labile form and is believed to be the principal site of vulcanization. The degree of crystallinity in a neoprene is largely dependent upon the amount of trans configuration in the polymer. Increasing amounts increase the degree of crystallinity.

RELATED PROCEEDINGS

APPENDIX

None

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